Isham's Diving Torpedo Shell Latest Marvel in Projectiles

New Invention Effective Against Armor Where Old Type Would Fail—Capable of Dealing Death Blow Even When Falling Short of the Target

By ROBERT G. SKERRETT.

ARE the ordnance experts of our navy any the wiser for the world war? Are the men that design the guns and the projectiles for our fighting fleet going to profit by the lessons of the battle of Jutland? Are they going to depend upon the same methods of attack to which they have subscribed persistently for many years?

These queries are particularly pertinent at the present time in view of the fact that the General Board of the Navy has recently recommended that we make our battle squadrons second to none within the next five years. Whatever may be the warrant for such a policy, and these technicists no doubt know facts of which the public commonly is ignorant, the man in the street, the taxpayer, will at least want to be reasonably assured that the tremendous sums potentially involved in such a programme shall be expended to the best advantage. What is the prospect of the nation getting its money's worth if the suggested building scheme be carried out?

The purpose of this article is to point out wherein we have apparently failed to see aright some vitally important ordnance problems, and there is reason to believe that we must mend our ways unless we are willing to invite a future conflict by weaknesses that would make us a relatively easy prey for an enemy not hampered by bureaucratic conservatism. The writing has been upon the wall in the years gone for those that cared to read; and cumulative evidence to the same end has been given frankly recently by no less an authority than Admiral Viscount Jellicoe of Scapa.

Naval Rifles Most Used.

Even the layman knows that the powers of a battle craft of the first order are variously divided between attack and defence; and up to date the principal medium of attack has been the long range, powerful naval rifle, depending for the most part upon different sorts of armor piercing projectiles to smash through the foe's protecting walls of steel and then to burst with a maximum of violence amid the enemy's "vitals." That is to say, to spread flame and hurtling fragments in the engine rooms, the boiler compartments and the magazines and shell rooms.

Theoretically, the capabilities of armor piercing shells to bore their way through defensive steel in time of battle have been established time and time again under ideal circumstances on the proving ground. Similarly, much the same thing has been achieved but with less spectacular success on the target range, where fighting craft have blazed away at some obsolete battleship with wind, atmosphere and the state of the water contributing to accuracy of practice and the favorable impingement of the noses of the projectiles against the so-called sheltering barrier of metal. It was in the faith inspired by kindred tests that the British Grand Fleet essayed to square accounts with the German forces in the spring of 1916 off the coast of Jutland.

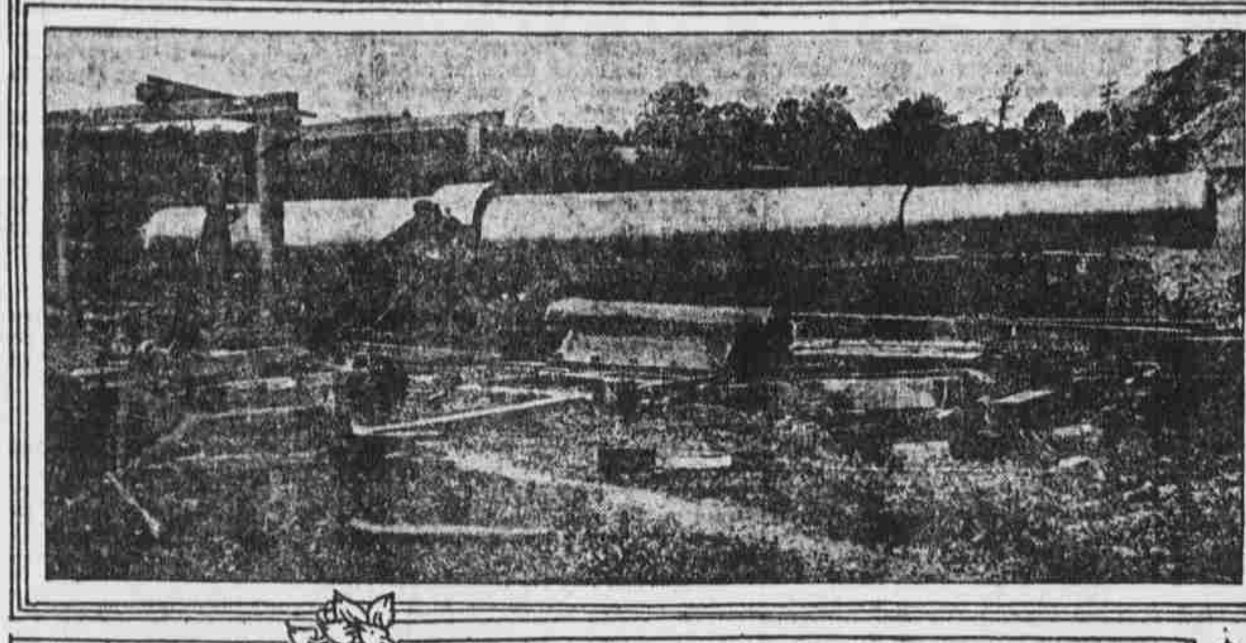
It is a matter of pretty general knowledge that something went wrong during that crucial conflict; and despite the splendid practice of the men behind the guns of Jellicoe's forces, still a great many of the Kaiser's ships got back to their home ports when they should have gone to the bottom if all of the hits landed upon them had told effectively. British marksmanship was of a high order, and salvo after salvo of great armor piercing projectiles repeatedly straddled the dreadnoughts and battle cruisers of Admiral Reinhold von Scheer's fleet. On the other hand, the Teuton shells wrought a vast deal of havoc, and one or two broadsides sufficed in some instances to cause the shockingly prompt foundering of big British craft.

Jellicoe's Version.

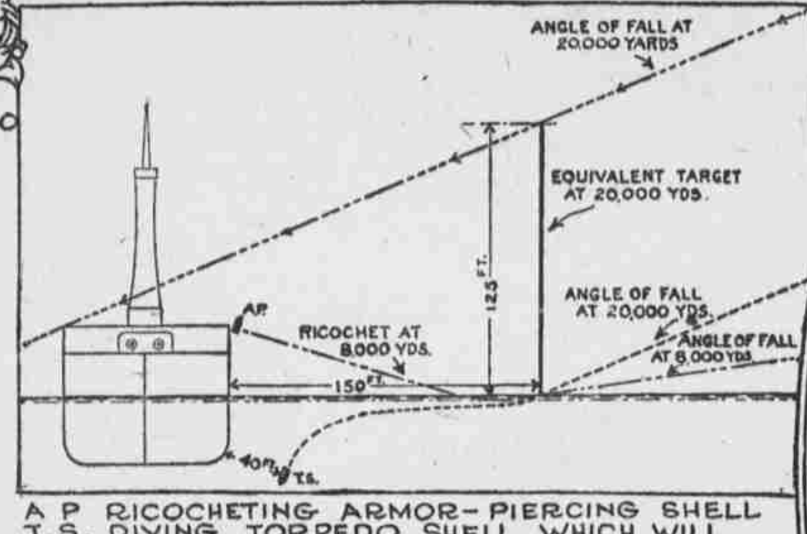
Admiral Jellicoe in his revealing book, "The Grand Fleet," thus explains a denouement that has dismayed the naval world which has looked upon the British fleet hitherto as the best example of preparedness in all particulars. "The Jutland battle convinced us that our armor piercing shell was inferior in its penetrative power to that used by the Germans, and immediately after the action I represented this with a view to immediate investigation. A committee sat to consider the matter. In 1917, as First Sea Lord, I appointed a second committee."

Continuing, this eminent and dispassionate authority says: "With one of the old type of armor piercing shells of a particular calibre as used at Jutland the shell would, with oblique impact at battle range, break up while holing a certain thickness of plate, and the shell could not, therefore, reach the vitals of the enemy's ships. A shell of the new type, as produced by the 1917 committee, of the same calibre would at the same oblique impact and range pass whole through a plate of double the thickness before exploding, and could, therefore, with delay action fuse penetrate to the magazines of a capital ship."

In passing, don't let us forget that Lord Jellicoe describes an improvement which probably had no more convincing test than proving ground trials and accordingly, may and possibly may not have demonstrated what would happen during a battle in the open sea, with the enemy vessels zigzagging to increase obliquity of impact and the rolling motion of those ships at long range also promoting acute angles of striking. The British still persisted in devising projectiles which would effect penetration with delayed bursting—pursuing the same questionable circle of procedure that had previously failed. Admiral Jellicoe, therefore, concludes: "Had our ships possessed the new type of armor piercing shell at Jutland many of the enemy's vessels, instead of being only damaged, would probably not have been able to reach port."

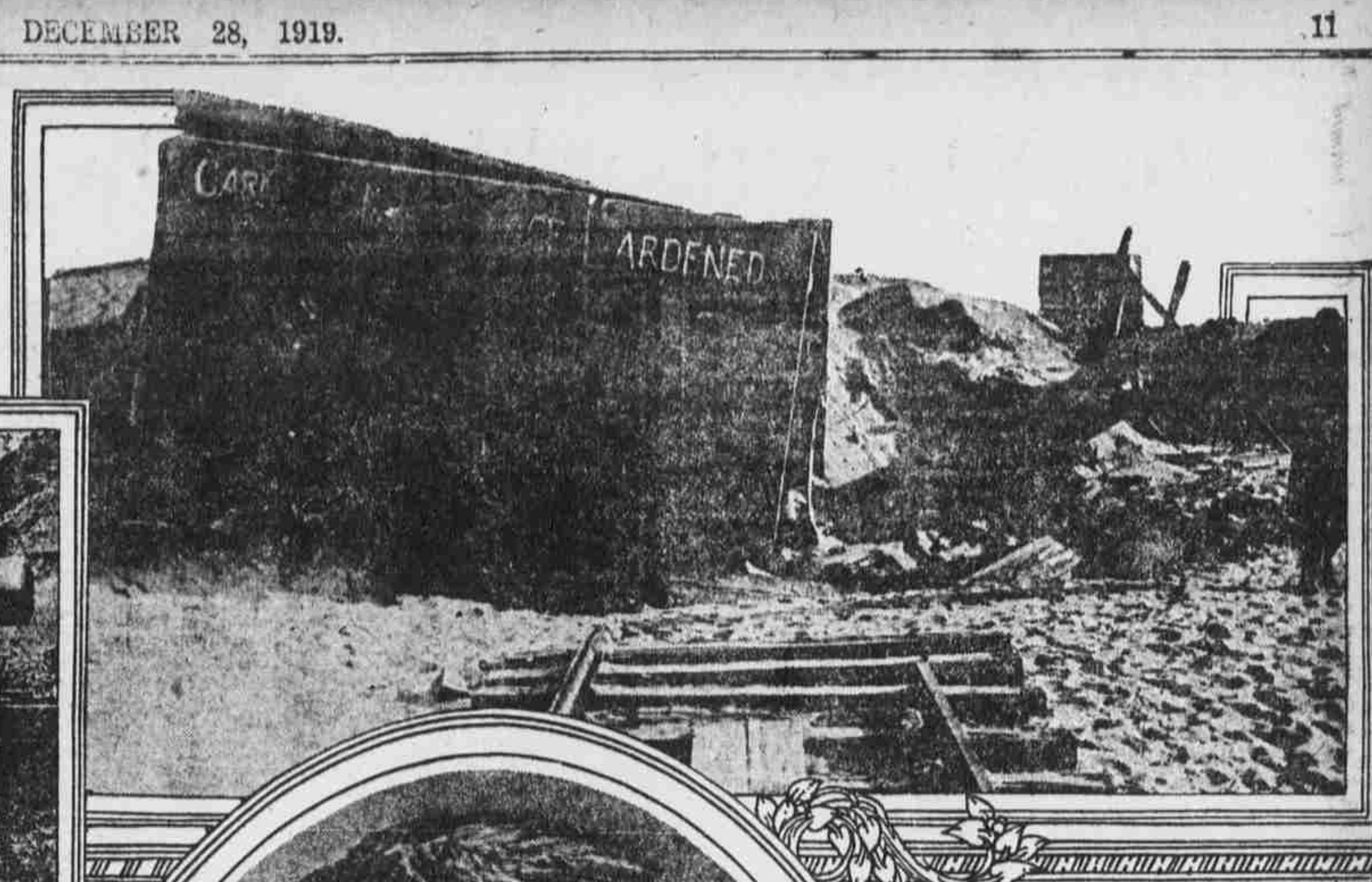


THE GREAT GATHMANN GUN THAT HURLED 18-INCH TORPEDO SHELLS



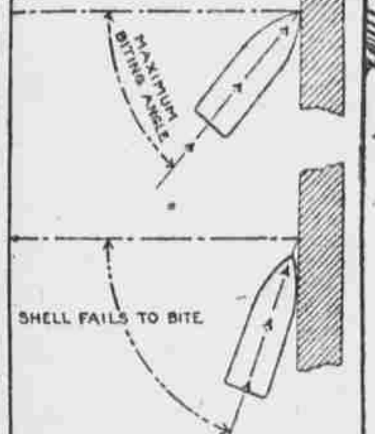
A P RICOCHETING ARMOR-PIERCING SHELL T.S. DIVING TORPEDO SHELL WHICH WILL SINK A SHIP WHEN EXPLODING 40 FEET AWAY The "EQUIVALENT TARGET" INDICATES TOTAL AREA VULNERABLE TO The TORPEDO SHELL

HIT WHERE IT MAY, ABOVE OR BELOW WATER, The TORPEDO SHELL WILL SPREAD RUIN.



WHAT GATHMANN SHELLS DID TO A TARGET SIMULATING The WATERLINE BELT of The BATTLESHIP IOWA

WILLARD S. ISHAM, INVENTOR of The LATEST TYPE of TORPEDO SHELL



PENETRATIVE LIMITATIONS of The ARMOR-PIERCING SHELL. DATA FURNISHED TO CONGRESS by BUREAU of ORDNANCE, NAVY DEPARTMENT

What then was it that made it practicable for the Germans to score more effectively when their projectiles were opposed by the heavy armor of the British battle craft? There is a persistent and well founded belief that the Teutons used a type or types of high explosive shells designed to burst upon impact when meeting any substantial barrier to their flight. That is to say, it is supposed that these missiles carried exceptionally large charges of TNT or something akin to it and that they were made to detonate instantly upon meeting an obstacle, the violence of this external blast being sufficient to do an immense amount of damage. If this be true, then the Germans utilized inventions developed in this country quite two decades ago.

Gathmann's Opposite Method.

As far back as 1898, Louis Gathmann, a naturalized American of German birth, conceived a method of attacking heavily armored defences, whether ship or fort, by means of thin walled shells loaded with a great mass of high explosive. His aim was not to pierce the protecting walls of steel, but to effect havoc by detonating the charge on the outer face of the defensive metal. This was directly opposed to the views held by the experts that went "by the book."

In May of that year, a turret plate of Harveyized nickel steel, seventeen inches thick, was stood upright at Indian Head, Maryland, and 500 pounds of wet guncotton, in contact with the armor, was detonated by electricity. The explosion split the plate from top to bottom and hurled the pieces violently rearward. That performance failed to alter the views of the Bureau of Ordnance of the Navy Department.

Two years later, Mr. Gathmann, despite the antagonistic attitude of both army and navy experts, obtained an appropriation from Congress for the building of an 18-inch gun to fire his torpedo shells, and then another appropriation was made to put the weapon and its projectiles to a test in competition with an army 12-inch rifle using armor piercing projectiles charged with dunnite. There was evidence in plenty that the Gathmann projectiles did not detonate as they were designed to do, but, despite the incompleteness of this function, they still made manifest their potentialities as wrecking or destructively wracking mediums.

The Gathmann shells were fired competitively without any previous preparatory tests, while the rival army projectiles had undergone prior firing trials and their erratic behavior was corrected by successive adjustments.

The army shell made a nice, clean circular hole in the target plate and burst in the rear of the armor, damaging the supporting structure considerably. Had the target been a ship the projectile could not have done its damage below water, for the sea would have stopped the shot. The Gathmann shell exploded against the face of the target, "dished" the heavy plate somewhat, and drove the steel backward and sideways a number of inches, shearing the rivets of the target framework both at the top and at the bottom. At first blush, Mr. Gathmann appeared to have failed, because the work of his projectile was not as outstandingly spectacular as that of the rival army missile. But wait a moment.

Made 12 Inch Hole.

The army shell made a passage through which the sea might have entered had the wound been upon a listing ship, and the twelve inch hole had an area of 113 square inches. On the other hand, the torpedo shell dislodged the armor plate so that the leakage area would have been equal to a hole 3 feet by 4 feet, or an area of twelve square feet below the water line! Through an opening of that magnitude in the side of a damaged craft 300 tons of water could rush in the course of a minute. In the face of this target damage, however, the joint army and navy board reported that the Gathmann shell "would not have endangered a vessel."

Without touching further upon the controversy which grew out of Mr. Gathmann's efforts to obtain recognition from the ordnance experts of the land of his adoption, let it be remarked that the Germans were from the start keenly interested in the competitive tests made at Sandy Hook. Competent and unbiased ordnance authorities have not hesitated to ascribe the success of the Germans in battering down the French and Belgian armorclad forts, believed until then impregnable, to recourse to torpedo shells loaded with trinitrotoluol instead of the wet guncotton which Mr. Gathmann had used more than a decade previously. To throw these projectiles the Teutons developed eleven inch mortars, which assured high angle, plunging fire.

The layman probably is not quite clear in his mind as to the difference between an explosion and a detonation. In the latter case the entire mass of the explosive is set off instantly, and the resulting violence of the gases is directed outward against either the walls of a container or the exterior air with inconceivable velocity. That is to say, the element of time is the determining factor between an explosion and a detonation, and the incandescent gases in the latter case drive against the air with a lightninglike suddenness which causes the air to react with the rigidity of a tremendously thick barrier. As a result, armor plating for the nonce becomes relatively more plastic and will give under the impulse of such a blow delivered upon its exterior surface.

The thing to be borne in mind then is that a detonating shell will do damage whether the opposing steel wall is thick or thin, while the armor piercing projectile must be slowed down by a massive barrier—otherwise it will simply make a succession of clean holes through intervening thin plates and pierce a ship from side to side and burst harmlessly after doing so. With a torpedo shell the whole of an enemy craft is an effective target and hitting it anywhere may lead to a disastrous consequence, but an armor piercing projectile is of comparatively little avail unless it happens to strike just where the armor plate is massive enough to bring the delayed action fuse into service before the missile can get clear of the vessel.

Travels Under Water.

Louis Gathmann is now dead, but a more ingenious advocate of the torpedo shell survives to carry on the struggle against the armor piercing projectile, pure and simple. Willard S. Isham of 520 Rhode Island avenue N. E., Washington, D. C., is the inventor of a torpedo shell which, if it falls short of its mark, will dive into the water and travel for 100 feet or more under the surface before reaching a depth greater than that of the draft of modern superdreadnoughts and battle cruisers. Should it strike the bottom of a ship while diving the missile will detonate instantly and bring its charge of high explosive to bear where the craft is least capable of resisting attack. That is to say, a shell of this sort that falls short of its target may still be able to deal the foe a death blow.

The ordinary shell, on the other hand, when impinging upon the water short of its mark, if the angle be not too nearly vertical, will glance off again, ricochet, and make a second flight at a sufficient altitude possibly to pass harmlessly over the target ship. Admiral Jellicoe, so it is said, has disclosed that the great majority of long range shots strike short. Arthur Pollen, the well known British civilian naval critic, has also made disclosures regarding the battle of Jutland, and he asserts in his latest book that a very large percentage of long range projectiles fall short of their target by anywhere from twenty to thirty yards and for the most part ricochet over the objective or strike where they do but little serious damage.

The shortcomings of the armor piercing projectile were brought out by certain experiments conducted against the old monitor Puritan and the target ship San Marcos some years ago before the world war, and similarly the potency of the external attack of a high explosive was demonstrated but belittled by our ordnance experts then in power in the Bureau of Ordnance. They could not alter their preconceived theories, for to do so would have meant the abandonment of instrumentalities which they declared to be indispensable.

To be brief, the armor piercing projectile did measure up reasonably well at comparatively short range—a range well within the effective reach of the automobile torpedo, but it was also made manifest that the armor piercing shell would be of very doubtful value at fighting distances beyond the then acknowledged range of the torpedo.

The man in the street must bear in mind the fact that battle craft are kept at arm's distance by the torpedo, which is capable of hitting below the water line where the powers of resistance are lowest; and, therefore, in order to cripple one another hostile capital ships rely at the greater distances upon gunfire, which is counted upon to batter down and to break through the foe's sheltering coat of mail. A prerequisite to success at the longer ranges is that the armor piercing shell shall be capable of remaining intact until it has perforated the defensive walls of steel. It can do this provided the angle of impact is not too oblique for the point of the shell to "bite," and, further, that the remaining velocity is high enough to drive the shot through the opposing metal.

Effective at 15,000 Yards.

Admiral Jellicoe tells us that the torpedo in 1916 had an effective range of 15,000 yards. At 15,000 yards, with ships zigzagging and possibly rolling in a seaway, the angles of impact are very likely to be so sharp that "biting" is an exception rather than the rule, while the projectiles, if striking short, will be very apt to ricochet. The next naval battle will in all likelihood be opened up at ranges of 20,000 yards and more, reducing to a still greater extent the effectiveness of the necessarily flatter flight of the strictly armor piercing type of missile, which depends upon high velocity and directness of impact to carry it through the enemy's defensive plating.

The torpedo shell, such as has been conceived by Messrs. Gathmann, Isham and others, does not rely upon its striking velocity to increase the power of its attack. Upon impact at any speed these projectiles will detonate and deal a maximum blow, and the angle of their impact is not essential to success. In this respect they are much akin to subaqueous torpedoes, save that they are hurled through the air instead of being self propelled.

But the Isham shell has another characteristic which makes its kinship to the automatic torpedo still closer than the Gathmann invention. If it strikes the water a hundred or more feet short of its target it will dive and continue to advance toward the objective. This is induced by a cup shaped cavity in the nose of the missile which causes it to bite and penetrate the water instead of glancing off from it and ricocheting skyward.

As long as Mr. Isham could not prove that his torpedo shell would dive and travel for some distance under the surface at a menacingly moderate depth, his critics were willing to concede that this form of attack, if attainable, would be a peril to battle craft. They wouldn't admit, however, that his invention would work. Congress had more faith in Mr. Isham's proposal and therefore directed that his weapon be subjected to practical trials. Rear Admiral Bradley A. Fiske was made the senior member of a board called into being for this purpose, and the body so constituted devoted about nine months to inquiring into various phases of the matter.

Admiral Fiske's Statement.

Under date of July 21, 1915, Rear Admiral Fiske made an individual statement to the Secretary of the Navy which impartially summed up the performances to that date. The following extracts will suffice for the present purpose in showing that Mr. Isham was making headway in a very desirable direction. To quote: "The board has experimented with the Isham fuse and shell for about nine months. During this time Mr. Isham has changed the details of his fuse from time to time. In my opinion the changes have always been in the line of improvement. At the present moment the fuse has not been brought to perfection because it has not demonstrated its ability to detonate a high explosive. In my opinion this is practically the only element in which it falls short, because it has accomplished the two other things which it attempted—that is, the fuse will act at once if it penetrates thin iron, such as the hull of a destroyer, and will act in about a second after it strikes water. In my opinion the only thing remaining to be accomplished is actual detonation, and this seems to me a matter of engineering and not of invention that can be accomplished simply by a proper proportioning of the component parts of the fuse.

"The inventor claims that the shell if it strike a very considerable distance short of a ship will run under water toward such ship and explode if it hit the underwater body of the ship, or if it fails to hit the underwater body of the ship, will explode about a second after reaching the water. The board made a series of experiments to determine whether the shell would make a long enough run under water to render this feature valuable to naval gunnery. Ten nets were sunk in the lower end of the Potomac, ten yards apart, one behind the other, each net being ninety feet long and suspended between two piles. One run of sixty yards was secured and others of shorter length, indicating, in my opinion, that if the action of the fuse to detonate the shell could be depended on the length of the underwater run was sufficient to make this an element of value in naval gunnery."

Rear Admiral Fiske recommended that the experiments should be continued. This was not done.

Before the world war the British Admiralty conducted experiments with torpedo shells, and the Empress of India, an armored ship, was sunk at a range of 16,000 yards. According to reports, "great gaps were blown in her side as big as lock gates." But in the early period of the recent conflict, owing to the untimely explosion of projectiles loaded with picric acid, the Grand Fleet, according to Admiral Jellicoe, was skittish of such missiles, and it is evident that the armor piercing shell became the accepted weapon. To-day we know that TNT is a thoroughly safe high explosive, notwithstanding its enormous powers when properly detonated; and Mr. Isham is thoroughly satisfied now that his fuse is capable of functioning correctly.

Ball Bearing Failed.

As he says, "I have improved my fuse since the tests were made, and failure then was due to a defective ball bearing, which could not stand the pressure to which it was subjected. This could have been determined in the first month of tests made by the Fiske board had that organization been furnished, as requested, with the assistance of fuse men. High explosives have been used in shells for the last twenty years or more, but prior to the war only in small quantities—just sufficient to break up and spread out the fragments as they continue in their forward movement. The great strength of high explosives made it possible to construct shells with thick walls that could be fired through armor under certain favorable conditions and break up into pieces after effecting penetration. This use in shrapnel and armor piercing shells is entirely different from the manner in which I propose to use high explosives in shells and from the way they were used in Belgium. My aim is to employ the projectile merely as a carrier for the destructive charge, which should, therefore, be the maximum to secure the greatest results.

"Velocity is useful merely because of its necessity to secure range. On land such missiles will destroy any structure that may be employed as a defence, and will fill up or bury any earthwork or dugout employed to protect men. At sea such projectiles will destroy the armored protections of battleships at any range within reach or when presented at an angle, as is now nearly always the case in naval battles, at which armor piercing shells will do nothing. Torpedo shells will act as torpedoes or mines if striking even 175 feet short of the target, and a single projectile of this sort of 12 inch calibre will put a ship out of action, for the missile will carry 200 pounds of TNT. A 14 inch shell will have a bursting charge of 300 pounds and a 16 inch shell will be loaded with 450 pounds of this powerful explosive.

"It should be remembered that a 12 inch torpedo shell with 200 pounds of TNT will have a greater effect than an automobile torpedo with a charge of 300 pounds, because in the latter weapon the explosive force will first be exerted backward into the air flask of the torpedo, having a capacity of forty cubic feet, thus robbing the explosion of much of its violence."

Inasmuch as the old battleships Massachusetts and Indiana are destined to be used as targets—replacing the San Marcos—there are the best of reasons why the Isham torpedo shell and similar missiles should be tested out in competition with the best of our armor piercing projectiles. It will be recalled that both the Bethlehem Steel Company and the Carnegie Steel Company in 1916 threw up their contracts with the Navy Department because they were then expected to supply projectiles that would penetrate heavy steel plate at an angle of 19 degrees from the normal. The experts of those concerns stated that it was impossible to do that. Several years earlier the navy was able to perforate twelve inch plates successfully at the proving ground with projectiles that broke up later on eight inch armor at an actual range of 10,000 yards during tests in Chesapeake Bay.

The recent war has emphasized the vulnerability of battle craft below water, and the torpedo shell promises to do all that the automobile torpedo can do and to achieve this at ranges far beyond the reach of the latter. Not only that, but the torpedo shell, owing to its far higher velocity, will stand a much bigger chance of reaching its mark than its comparatively sluggish rival, which must travel all the way by water, perhaps to find its quarry hundreds of yards away when the path of the target is crossed.